

U.S. Patent Application Serial No. 09/664,332

REMARKS

The Examiner states that the Information Disclosure Statement filed April 25, 2002, failed to comply with 37 CFR1.97 (c) because it lacks the fee. Page 2 of the Information Disclosure Statement filed on April 25, 2002, states:

"The Commissioner is authorized to charge our Deposit Account No. 01-2340 for any fee which is deemed by the Patent and Trademark Office to be required to effect consideration of this statement."

Applicant requests that the Examiner consider the outstanding Information Disclosure Statement and charge any fees per the instructions of the Information Disclosure Statement.

Applicant's Response to the Examiner's Rejection Under §103

Applicant has amended claims 1 to include the limitations of claim 20. Namely, the proportional parts by weight of the photopolymerization initiator component is clarified to be between 0.1 and 6.0 parts. Applicant respectfully submits that one skilled in the art would not be able to discern this combination in light of the cited references because none of the cited reference teach or suggest this proportional combination.

Buchwalter et al. discloses that when the curing epoxy resin component, the polymerization can be performed by using a sulfonium salt compound as well as maleic acid as a curing agent. However, with respect to the proportions of the composition in *Buchwalter et al.*, a photoinitiator has a proportion of 16 wt% (0.54/3.3 parts by weight) (*see col. 9, lines 55-56*).

On the contrary, in the present invention, the photopolymerization initiator component is

contained in a proportion of 0.1 to 6.0 parts by weight of the components excluding the photopolymerization initiator component.

As such, the present invention has a totally different composition proportion of photo initiator than that of *Buchwalter et al.*

Buchwalter et al. does not suggest at all that photo-thermopolymerization initiator in the Formula specified in the present invention, if combined with maleic anhydride, shows a high curing characteristic compared to conventional inventions. Accordingly, in *Buchwalter et al.* a large amount of polyinitiator is added in a proportion completely different from that of the present invention.

Starkey discloses that when curing the epoxy resin component, the polymerization can be performed by using iodonium salt or sulfonium salt compound as well as an additive such as polyol. In addition, *Starkey* teaches that maleic anhydride is added as a thermohardening catalyst.

However, the thermohardening catalyst or a mixture thereof is used in an amount from 0.01 to 10 parts by weight based on 100 parts by weight of the resin component of the resin composition (column 21, lines 12-16). It further describes that when the amount of the same exceeds 10 parts by weight, the resulting resin composition suffers from problems such as precipitation of the catalysts or a decrease in the stability of the liquid.

Whereas, the present invention discloses a composition, wherein the curing agent component is present with a proportion of 0.1 to 1.4 mol per mol of the photopolymerizable resin component. In Example 1 of the present invention, maleic anhydride 0.65 mol was added to one

mol of epoxy resin, thus the curing agent component is present in a proportion of 25.2 parts by weight per 100 parts by weight of the resin. Hence, the composition of the present invention shows a high curing characteristic in a proportion *Starkey* teaches away from. Furthermore, a predetermined amount of a curing agent component (maleic anhydride) that helps heat curing is required in the present invention. *Starkey* does not suggest that a photothermopolymerization initiator in the Formula specified in the present invention, if combined with maleic anhydride, would result in a high curing characteristic compared to conventional inventions. Nor does *Starkey* suggest any other reason for such a specific combination.

In regard to *Green et al.* '938 and *Green* '592, they disclose that when curing the epoxy resin component, the polymerization can be performed by using sulfonium salt compound as well as a curing agent such as a polycarboxylic acid anhydride.

These references, however, do not suggest the composition obtained by blending an acid anhydride such as maleic anhydride with a photo-thermopolymerization initiator as disclosed in the present invention, let alone, the proper ratios of such a blend.

Accordingly, one skilled in the art in light of the *Green* references cannot anticipate the specific composition proportions of the specified photo-thermopolymerization initiator and acid anhydride relating to epoxy resin in order to obtain a composition having a superior curing characteristic.

Hamazu et al. discloses the stabilizer which can preserve a specific sulfonium salt compound used for curing the epoxy resin component.

However, *Hamazu et al.* does not teach the addition of acid anhydride such as maleic

anhydride. Thus, it does not suggest how a sulfonium salt compound is combined with an acid anhydride to accelerate the curing of epoxy resin component.

✓ *Ohnishi* discloses that when curing the epoxy resin component, the polymerization can be performed by using a curing agent as well as a specific salt compound. However, *Ohnishi* does not suggest the necessary composition proportion of the sulfonium salt compound and specific acid anhydride (maleic anhydride) need for almost simultaneous energy ray and heat curing of the epoxy resin component. Neither of *Hamazu et al.* nor *Ohnishi* teaches nor suggests the above type of curing.

The present invention provides an outstanding invention in which curing can proceed not only on a surface of the composition, but also in the inside (depth) of resin molded article. This type of curing is not described in any of the above references. The above effect is produced for the first time by using the combination of the specific sulfonium salt compound and acid anhydride in the proportion specified in the present invention.

Attached please find Applicant's additional experiment data demonstrating the effect of the present invention. As clearly shown in the data, when the specific sulfonium salt compound is combined with acid anhydride, the sample was completely cured at the liquid depth of 40 mm. This is because the present invention utilizes both energy-ray curing and heat curing. Therefore, curing proceeds by chain reaction even at the depth where no light reaches at all, so that the photopolymerizable resin can be cured over a wide composition range.

Whereas, as shown in Comparative Examples 1 and 2, when a sulfonium salt other than that specified in the present invention is used, the sample was cured only on a surface thereof and

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not cured completely. In other words, curing did not occur at all at the depth at which light did not reach. Regarding this, heat curing owing to the chain reaction did not proceed because the specific sulfonium salt of the present invention is not combined with acid anhydride.

In the present invention, the specific sulfonium salt and the curing agent component is used at a specific ratio in relations to the resin component. Thereby, the above specific salt functions as the photopolymerization initiator.

It is not anticipated from any of the above references that curing capacity can be extremely improved by combining the specific sulfonium salt of the present invention with acid anhydride in the specific composition proportion. As such, if one skilled in the art were to combine the above references to obtain "the specific advantages mentioned in *Buchwalter et al.* and *Starkey*" as the Examiner suggests, they would not derive the present invention.

Claim 1 has been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicant regards as his invention. It is believed that this Amendment is fully responsive to the Office Action dated **December 3, 2002**.

In view of the aforementioned amendments and accompanying remarks, claims, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

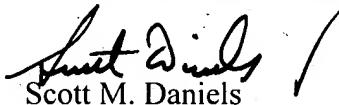
Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

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In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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PATENT TRADEMARK OFFICE

Enclosures: Version with markings to show changes made
Petition for Extension of Time w/fee
Experiment Data

Q:\FLO\ATTERS\Mike Caridi\00\001195\Response to Final OA-2-30-03



CONVERSION WITH MARKINGS TO SHOW CHANGES MADE
PATENT APPLICATION SERIAL NUMBER 09/664,332

IN THE CLAIMS:

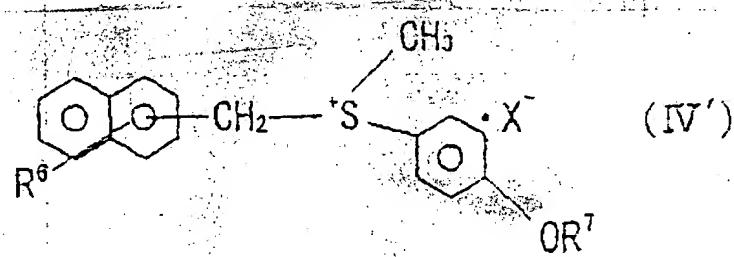
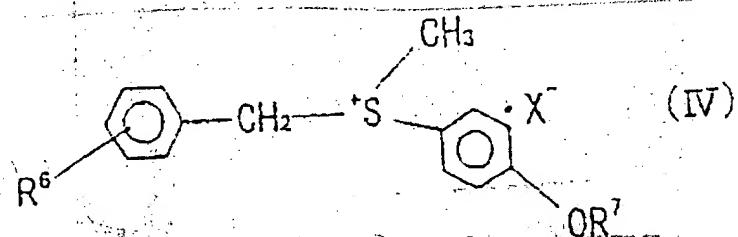
Claim 20 has been canceled without prejudice or disclaimer.

Claim 1 has been amended as follows:

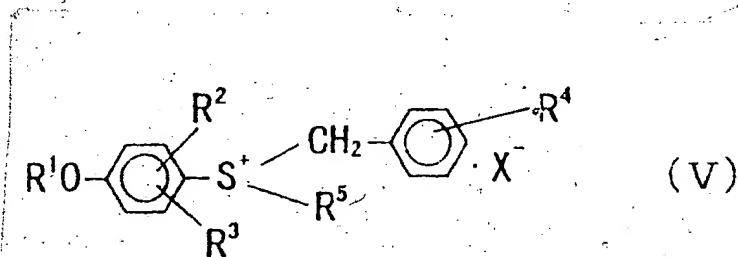
1. (Amended) An energy-ray curing resin composition comprising a photopolymerizable resin component which can be cured by irradiation with an energy ray, a photopolymerization initiator component which makes it possible to cure said photopolymerizable resin component with irradiation of an energy ray, and a curing agent component capable of curing at least one of said photopolymerizable resin components without irradiation of an energy ray,

wherein said curing agent component comprises an acid anhydride or a derivative thereof,

said photopolymerization initiator component comprises a sulfonium salt, the sulfonium salt being a photo-thermopolymerization initiator which can initiate polymerization by both of light and heat, and being represented by the following general formula (IV), (IV'), or (V):



in Formula (IV) or (IV') described above, R⁶ represents hydrogen, halogen, a nitro group or a methyl group; R⁷ represent hydrogen, CH₃CO, or CH₃OCO; and X⁻ represents SbF₆⁻, PF₆⁻, AsF₆⁻ or BF₄⁻;



in Formula (V) described above, R¹ represents hydrogen, a methyl group, an acetyl group, or a methoxycarbonyl group; R² and R³ each independently represent hydrogen, halogen or an alkyl group of C₁ to C₄; R⁴ represents hydrogen, halogen or a methoxy group; R⁵ represents an alkyl group of C₁ to C₄; and x represents SbF₆⁻, PF₆⁻, AsF₆⁻ or BF₄⁻, and

wherein said curing agent component is present with a proportion of 0.1 to 1.4 mol per mol of said photopolymerizable resin component which can react with said curing agent component[.]

wherein said photopolymerization initiator component is present with a proportion of 0.1 to 6.0 parts by weight per 100 parts by weight of the whole weight of the other components than the photopolymerization initiator component.

Experiment data

Added Example 1

Maleic anhydride 0.65 mol was added to one mol of Celoxide 2021P (alicyclic epoxy resin; 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane-carboxylate, manufactured by Daniel Chemical Co., Ltd.) and dissolved by stirring to obtain a solution. - (a)

50wt% of Sun Aid SI-80L (cationic photo-thermopolymerization initiator; Formula (IV), manufactured by Sanshin Chemical Co., Ltd.) was made by using α -butyrolactone as a solvent. - (b)

Blended with 100 parts by weight of (a) was 1.0 parts by weight of (b). - (c)

A glass vessel (\varnothing 30 mm (inside diameter 27.5 mm) \times H 45mm) was charged with (c) so that the liquid height becomes 40 mm. This was irradiated with UV for 3 minutes. The irradiation conditions were a UV irradiation apparatus: UVL-1500M2 (manufactured by Ushio Denki Co., Ltd.), the kind of a lamp: metal halide lamp, a lamp intensity: 120 w/cm, a lamp length: 125 mm, in the air, at room temperature, under atmospheric pressure and an irradiation distance: 15 cm.

The sample described above was completely cured in several minutes while chain curing.

Added Example 2

The same test as in Added Example 1 was carried out, except that Sun Aid SI-60 (cationic photo-thermopolymerization initiator; Formula (IV), manufactured by Sanshin Chemical Co., Ltd.) was blended in place of Sun Aid SI-80L.

The sample described above was completely cured in several minutes while chain curing.

Added Example 3

Prepared was a mixture of CYRACURE UVI-6974 (cationic photo-thermopolymerization initiator (sulfonium salt), manufactured by Union Carbide Co.) and (b) in the Added Example 1 with a ratio of 8:2. - (d)

The same test as in Added Example 1 was carried out,

except that (d) was blended in place of (b).

Added Comparative Example 1

The same test as in Added Example 1 was carried out, except that DAICAT 11 (aryl base sulfonium salt type/solvent = 1/1, manufactured by Danicel Chemical Co., Ltd.) was blended in place of (b).

The sample described above was cured only 2 mm from the surface thereof, and the remainder was still liquid.

Added Comparative Example 2

The same test as in Added Example 1 was carried out, except that CYRACURE UVI-6974 (cationic photo-thermopolymerization initiator (sulfonium salt), manufactured by Union Carbide Co.) was blended in place of (b).

The sample described above was cured 18 mm from the surface thereof, but the remainder was still liquid.